

## Project Name: Mini-Plate Boundary Observatory

### Principal Investigators:

Paul Silver, Carnegie Institute of Washington  
Barbara Romanowicz, UC - Berkeley  
Malcolm Johnston, U. S. Geological Survey  
Yehuda Bock, UC - San Diego

**Estimated Start Date:** June 2001

**Duration of Study:** Ongoing

## PBO Project Summary

### Abstract

The U.S. Geological Survey (USGS) recently released a report on the probability of a magnitude 7 earthquake occurring in the San Francisco Bay Area. There is a 70% chance that one or more of the Bay Area's many active faults may produce such an event near its population centers. Crustal deformation studies are currently underway aimed at improving the analysis of seismic hazards. During the summer of 2001, the USGS plans to build several new deformation stations in the Bay Area as part of the prototype Plate Boundary Observatory (PBO) program. These stations will expand an existing network of Bay Area sites instrumented to measure deformation within the seismically active zone of the tectonic plate boundary between the Pacific and North American plates. Deformation will be measured using borehole strainmeters, seismometers, pore pressure, and GPS (Global Positioning System) receivers. Some of these instruments will be installed at the surface while others will be cemented to solid bedrock at depths between 400 and 800 feet down a borehole. They will provide the information needed to see geodetic strain, microearthquake activity, and deformation at depth.

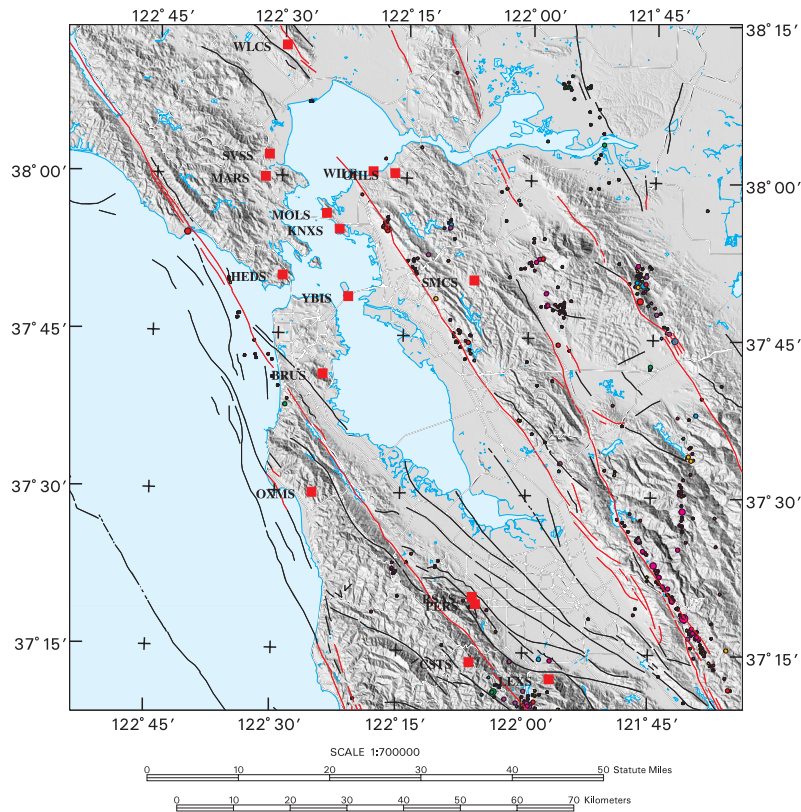
### Problem Statement

Nearly all earthquake and volcanic hazards exist along zones of concentrated crustal deformation at the tectonic plate margins of the earth. The plate boundary between the Pacific and North American plates, particularly in the Bay Area along the San Andreas fault, produces large earthquakes and crosses large urban populations, placing many people and much property in peril. Previous geodetic studies of crustal deformation relied upon costly and, at times, unreliable, periodic survey data. Since the mid-1990's, advancements in technology and a new focus of funding have enabled the creation of a network of stations providing continuous recording.

### Objectives

Ongoing recordings from geophysical stations will produce deformation and seismic information used to study plate boundary loading and seismic hazards. GPS measurements provide overall crustal movements at periods of a month or longer. Strainmeter measurements provide high precision deformation data at periods of milliseconds to months. This

Bay Area Deformation



allows earthquake source details and details of fault slip to be determined. Seismometers will complement surface geodetic data by registering earthquake vibrations generated at seismogenic depths. All data collected by the crustal deformation network would be available on the internet.

### Methods

Station installations include borehole 3-component strainmeter and seismic instruments at a depth of 400 to 800 feet. A GPS (Global Positioning System) antenna will be installed at the surface, using the borehole casing as part of a stable monument. A description of the station installation procedure follows.

#### Stage One : Borehole Drilling

Drilling of a 10" - 11" diameter borehole using fresh water, drilling mud and/or bentonite and/or nontoxic biodegradable viscosifiers, to a maximum depth of 800 feet. The borehole is cased with a cemented 6" steel casing. A GPS antenna monument would be placed over the borehole casing necessitating special borehole location providing a largely unobstructed sky view to the east, south, and west. All required environmental codes for the construction of boreholes will be met.

# U. S. GEOLOGICAL SURVEY BOREHOLE STRAINMETER INSTALLATION

## Stage Two : Instrument Installation

If stable, unfractured basement rock is encountered at a depth of 400 to 800 feet, a 10 - 40 foot core sample would be removed below the casing. Next a strainmeter would be grouted within the cored section, which would then be covered with 20 feet of cement. A seismic package would then be placed next in line followed by other instruments. Finally, the hole would be filled with cement to the surface. Where allowed, to conserve water, recycled water would be used for drilling.

## Stage Three : Electronics and Recorder Installation

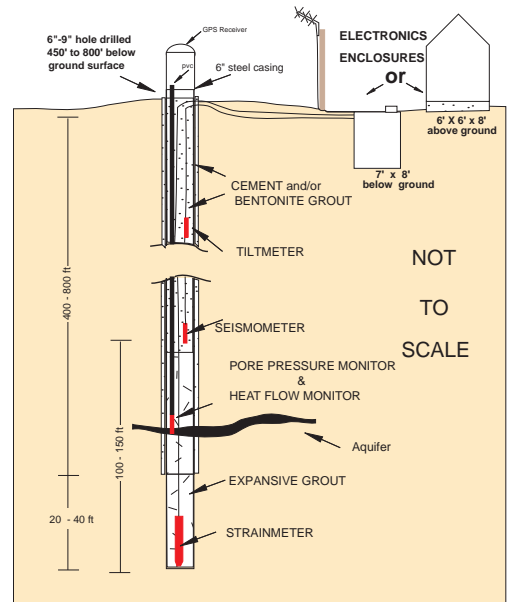
The following instruments would be housed in a concrete block enclosure at the surface approximately 25 feet from the borehole: data acquisition recorders, satellite transmitters, rechargeable batteries, atmospheric pressure transducers, and seismometer electronics. Connection to nearby power (solar may be an option) and phone lines would be required.

Equipment visible at the surface might include:

- 1) 6'x6'x8' high concrete block structure,
- 2) a GPS antenna monument (10" diameter x 4' casing extension with 18" diameter dome top) over the borehole,
- 3) satellite (12" x 24") and radio (8" x 12") antennas mounted on a galvanized metal pole ~10' tall.

Should visual screening of equipment be decided as necessary, the USGS will provide installation of plant materials, or other landowner approved remedy.

After installation is complete, annual maintenance visits would be required to retrieve on-site records and reset digital clocks.



## Contacts:

Bob Mueller 650-329-4857 [rmueller@usgs.gov](mailto:rmueller@usgs.gov)

Doug Myren 650-329-4858 [dmyren@usgs.gov](mailto:dmyren@usgs.gov)

